US-PAT-NO: 5949911

DOCUMENT-IDENTIFIER: US 5949911 A

TITLE: System and method for scalable coding of sparse data sets

DATE-ISSUED: September 7, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Chui; Charles K.	Palo Alto	CA	N/A	N/A
Zhong; Lefan	Palo Alto	CA	N/A	N/A
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APPL-NO: 08/ 858035

DATE FILED: May 16, 1997

US-CL-CURRENT: 382/240, 341/79 , 375/240.11 , 382/232

ABSTRACT:

A data encoding system and method successively generates compressed data on a bit plane by bit plane basis, starting with the bit position of the most significant non-zero bit for the node in the data array having the largest absolute value, and then encoding the data in the array for progressively less significant bits. All the nodes in the data array

are represented initially by
blocks of nodes on a block list, and later in the
processing by nodes on two
node lists. Whenever a block contains a node whose
most significant bit is on
the bit plane currently being processed, the block
will be subdivided
recursively until all the nodes in the block whose
most significant bit in on
the current bit plane are placed in a node list.
Data bits representing an
m.sup.th least significant bit of the block and
node values are written to the
compressed data file first, where m is the minimum
number of bits required to
represent the node having the largest absolute
value in the entire data array
being encoded. Data bits for successively less
significant bit planes are
written to the compressed data file until a bit
plane stop point is reached.
The bit plane stop point may be predefined, user
selected, or procedurally
selected (e.g., in accordance with available
bandwidth for transmitting
compressed image data).

30 Claims, 21 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 15

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Detailed Description Text - DETX (84):
If the on-the-fly image updating is enabled and
either the timer expires
and/or a predefined input file percentage threshold

(e.g., 30, 50, 70 or 90
percent of the compressed data file) is exceeded
(step 410) the interrupt
procedure is invoked (step 412) by the computer's
operating system. The
interrupt procedure first makes sure that the
compressed data has not already
been fully decoded by the decoder procedure (step
414). If not, the compressed
data that has been **decoded** so far is dequantized
and inverse **wavelet**
transformed so as to generate a **partially**
reconstructed image (step 416).

US-PAT-NO: 6587588

DOCUMENT-IDENTIFIER: US 6587588 B1

TITLE: Progressive image decoder for wavelet encoded images in compressed files and method of operation

DATE-ISSUED: July 1, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bottou; Leon	Highlands	NJ	N/A	N/A
Howard; Paul Glor	Morganville	NJ	N/A	N/A

APPL-NO: 09/ 464387

DATE FILED: December 16, 1999

PARENT-CASE:

This application claims the benefit of the filing date of provisional application Serial No. 60/124,660, filed Mar. 16, 1999 and assigned to the same assignee as that of the present invention.

US-CL-CURRENT: 382/240, 375/240.11 , **382/233** , 382/248

ABSTRACT:

A progressive image display decoder and method of operation for wavelet

encoded images achieves reduced memory storage requirements for wavelet transform coefficients and reduced execution time in displaying the image thereby overcoming the limitations of the prior art. Conveniently, a wavelet image format, typically DjVu IW44 facilitates progressive rendering and smooth scrolling of large color or gray level images with limited memory requirements.

The progressive wavelet decoder is composed of two components. The first component decodes the incoming image data and updates an array of wavelet coefficients. The second component applies an inverse wavelet transform to the array of wavelet coefficients for the purpose of reconstructing the image. The operation of the first component (the decoder) is triggered by the incoming compressed image data. The received data is decoded and is used to apply updates to an array of wavelet coefficients. Each update improves the accuracy of the coefficients and therefore improves the fidelity of the reconstructed image. The coefficient array is composed of several two-dimensional arrays (one for each of the color components) having one entry corresponding to each 32.times.32 blocks in the image. Each entry contains 1024 wavelet coefficients organized as a sparse array with two levels of indirection. The operation of the second component (the renderer) is typically triggered when enough data has been received to display an updated version of the image, or when the user performs an action which requires displaying a new part of the image. In the latter case, the renderer only reconstructs the

pixel values for the parts of
the image, which are needed. A further reduction
of the computation time is
obtained by using "lifting" for implementing a fast
inverse wavelet transform.

15 Claims, 11 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 6

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Drawing Description Text - DRTX (8):
FIG. 4 is a representation of a determination of **wavelet** coefficients for a
partial rendering.

Detailed Description Text - DETX (130):
FIG. 5 represents an image 48 divided in
32.times.32 blocks. The **partial**
rendering reconstructs a specified segment 50 of
this image on the basis of the
wavelet coefficients stored in an array 49 of
wavelet blocks (c.f. definition
section 2.2). The partial rendering consists of

Current US Cross Reference Classification - CCXR (2):
382/233

US-PAT-NO: 6658158

DOCUMENT-IDENTIFIER: US 6658158 B2

TITLE: Wavelet encoding method and apparatus and wavelet
decoding method and apparatus

DATE-ISSUED: December 2, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Fukuhara; Takahiro	Kanagawa	N/A	N/A	JP
Kimura; Seiji	Chiba	N/A	N/A	JP
Kiya; Hitoshi	Hachioji-Shi, Tokyo	N/A	N/A	JP

APPL-NO: 09/ 472293

DATE FILED: December 27, 1999

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	10-377713	December 29, 1998

US-CL-CURRENT: 382/240, 382/233 , 382/248 , 382/268

ABSTRACT:

A wavelet encoding method and apparatus and a wavelet decoding method and
apparatus for pictures. A input picture is split

into plural tile pictures and
wavelet transform is applied to input pictures on the tile picture basis to
effect the encoding. For wavelet transform, pixels lying on the outer side of
a given tile picture are symmetrically expanded and convolved. This enables
marked memory capacity reduction, while eliminating constraint conditions for
the number of times of wavelet splitting.

4 Claims, 33 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 19

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Brief Summary Text - BSTX (19):
Thus, according to the present invention, high efficiency encoding and high
quality **decoding** can be achieved since both the features of high quality under
high compression and **partial** tile picture **decoding** can be achieved and **wavelet**
transform means can be matched to inverse **wavelet** transform means.

Detailed Description Text - DETX (65):
Thus, inverse **wavelet** transform means, in which **wavelet** transform
coefficients in a range outside the current tile affected by filtering are all
set to 0 to effect convolution, is excellent in the realization of both the
high picture quality under high compression and **partial** tile **decoding**.

US-PAT-NO: 6501861
DOCUMENT-IDENTIFIER: US 6501861 B1

TITLE: Scalable coding/decoding methods and apparatus for producing still image using wavelet transformation

DATE-ISSUED: December 31, 2002

US-CL-CURRENT: 382/243; 382/240

APPL-NO: 09/ 398003

DATE FILED: September 16, 1999

PARENT-CASE:

This application claims priority under 35 U.S.C. .sctn..sctn.119 and/or 365 to 98-38419 filed in Korea on Sep. 17, 1998; the entire content of which is hereby incorporated by reference.

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
KR	98-38419	September 17, 1998

---------- KWIC ---------

Brief Summary Text - BSTX:

In an apparatus for scalably decoding encoded shape information on a still image using **wavelet transformation according to the**

present invention, each scalable decoder comprises means for receiving encoded shape information and dividing the shape information of the current layer and the shape information of the lower layers into **blocks,** means for bordering the respective **blocks** in the shape information, means for performing arithmetic decoding on the encoding mode determined according to the possibility of using the exclusive OR information of the respective pixels in the bordered **block,** means for scanning the respective pixels in a **block** in the ISL order decoding and decoding the pixels by exclusive OR information when the exclusive OR information can be used and obtaining the context information and performing the arithmetic decoding on the pixels when the exclusive OR information cannot be used, when the encoding mode is the ISL encoding mode, and means for scanning the respective pixels in a **block,** obtaining the context information, and performing the arithmetic decoding on the pixels, when the encoding mode is the ISL encoding mode.

Drawing Description Text - DRTX:

FIGS. 1A and 1B are **block** diagrams showing the structures of a still image encoder and a still image **decoder using wavelet** transformation;

Drawing Description Text - DRTX:

FIG. 5 is a **block** diagram showing the structure of a scalable shape **decoder** **using wavelet** transformation;

$\underline{y}$ representation at process block 1168 and an intra-frame encoded represen

US-PAT-NO: 6466697
DOCUMENT-IDENTIFIER: US 6466697 B1

TITLE: Data structure for image transmission, image coding method, and image decoding method

DATE-ISSUED: October 15, 2002

US-CL-CURRENT: **382/233**; 382/243

APPL-NO: 09/ 110458

DATE FILED: July 7, 1998

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	9-185548	July 10, 1997
JP	10-115521	April 24, 1998

---------- KWIC ---------

Brief Summary Text - BSTX:

In order to store or transmit digital image information with high efficiency, it is necessary to compressively code the digital image information. As a typical method for compressive coding of digital image information, there is DCT (Discrete Cosine Transformation) represented by JPEG (Joint Photographic Experts Group) and MPEG (Moving Picture Experts

Group). Besides, there are
waveform coding methods such as sub-band coding,
wavelet coding, and fractal
coding.

Brief Summary Text - BSTX:

Therefore, among a coded binary signal, a coded
arbitrary shape signal, and a
coded rectangle signal (coded pixel value signal),
only the coded rectangle
signal can be **selected and decoded by a decoding**
apparatus for **decoding** only
the coded rectangle signal which is obtained by
coding a pixel value signal for
color display of image.

Brief Summary Text - BSTX:

Therefore, among a coded binary signal, a coded
arbitrary shape signal, and a
coded rectangle signal (coded pixel value signal),
only the coded rectangle
signal can be **selected and decoded by a decoding**
apparatus for **decoding** only
the coded rectangle signal which is obtained by
coding a pixel value signal for
color display of image.

Detailed Description Text - DETX:

Further, the image decoding apparatus 100c
includes, instead of the data
analyzer 160 according to the third embodiment, a
data analyzer 166 which
generates a switch control signal SWc according to
the end detection signal Te
and the over-load detection signal Lov. The other

structure of the data analyzer 166 is identical to that of the data analyzer 160. Further, the image **decoding** apparatus 100c includes, instead of the switch 101b according to the third embodiment, a switch 101c which has an input terminal Cin, to which a coded image signal from the data analyzer 166 is input, and three output contacts Co1, Co2 and Co3, and **selects** one of the three contacts in response to the switch control signal SWc. The output contact Co1 is connected to the input of the arithmetic decoder 171, the output contact Co2 is grounded, and the output contact Co3 is connected to the input of the inverse quantizer 181 and to the input of the motion compensator 184.

Detailed Description Text - DETX:

In this seventh embodiment of the invention, emphasis has been placed on the image **decoding** apparatus 100e which **selects,** according to an image identifier, a coded signal including coded shape bit streams from the coded signals having the data structures according to the sixth embodiment, i.e., the coded arbitrary shape signal 1500, the coded binary signal 1600, and the coded rectangle signal 1700. However, when the image input unit 110 in the image coding apparatus 100a according to the second embodiment (refer to FIG. 3) is constructed so that it can identify an arbitrary shape image signal, a binary image signal, and a rectangle image signal, it is possible to implement an image coding apparatus that performs coding of

these image signals with image identifiers for identifying the coded signals corresponding to these image signals.

Detailed Description Text - DETX:

In this ninth embodiment of the invention, the coded shape bit stream is decoded by the arithmetic decoding method (first decoding method) in the shape decoding unit 170, and the coded texture bit stream and the coded transparency bit stream are decoded by the same decoding method including DCT. In other words, the decoding method for the coded texture bit stream (second decoding method) is identical to the decoding method for the coded transparency bit stream (third decoding method). However, the coded transparency bit stream may be decoded by a decoding method including **wavelet** processing or the like (third decoding method) which is different from the decoding method including DCT (second decoding method).

Current US Original Classification - CCOR:

382/233

US-PAT-NO: 6356667
DOCUMENT-IDENTIFIER: US 6356667 B1

TITLE: Encoding apparatus and method, decoding apparatus and method and recording medium

DATE-ISSUED: March 12, 2002

US-CL-CURRENT: 382/248; **382/233** ; 382/249

APPL-NO: 09/ 173116

DATE FILED: October 15, 1998

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	9-285447	October 17, 1997

---------- KWIC ---------

Brief Summary Text - BSTX:

After all of the IFS codes for all of the blocks have been read out, IFS read out circuit 206 sends a READ OUT END notification signal 310 to duplication control circuit 207. It is then determined by duplication control circuit 207 whether information for all blocks has been obtained. If not, a repeat command 309 is sent to IFS code read out circuit 206, the IFS codes 302 are input once again, and the procedure begins again. The

information for all blocks has been read out, and decoding continues through a recursive decoding procedure. Duplication control circuit 207 counts the number of recursive decoding/duplicating operations that have been executed, and if this count has not reached a predetermined value, duplication control circuit 207 sends a reprocessing command signal 311 to a switch 209 in order to send **partially decoded** picture 313 to reduced picture generating circuit 202 via information path 314. Reduced picture generating circuit 202 generates a **partially decoded** reduced size picture 315 of decoded picture 313 in a manner similar to that as in the encoding device in order to re-write the contents of the picture stored in reduced picture storage circuit 204 and to enable a next recursive **decoding step to start with partially decoded** reduced picture 315. If the predetermined number of recursive decoding operations have taken place, and thus the duplicating operation has been carried out the predetermined number of times, a decoded picture output control signal is sent by reprocessing command signal 311 to switch 209 in order to couple a decoded picture 313 output from decoded picture storage circuit 208 to a picture output port 316. Decoded picture 313 comprises a conglomeration picture of all of the decoded blocks noted above after being recursively decoded for a predetermined number of iterations and is read out from decoded picture storage circuit 208 in accordance with control signal 312.

Detailed Description Text - DETX:

Referring next to FIG. 11, a decoding apparatus constructed in accordance with the invention will now be described. This decoding apparatus may be employed for decoding information encoded by any of the iterative picture transforming coding devices explained above. A storage medium 400, a communication network 500, or other data input device provides an encoded bit stream to a decoding area picture controller 17. This decoding area picture controller 17 receives encoded bit stream 120 and decoding target area information 128 from an external input. This target area information 128 is used in controlling the portion of a picture, and thus bit stream 120, to be decoded. A demultiplex/decoder 9 for carrying out demultiplexing and **decoding receives the selected** portion 129 of encoded bit stream 120 and provides a number or address 111 of the first block portion 104 to be decoded to a picture memory 11 and provides a number or address 108 of the second block portion 106 corresponding to first block portion 104 and the screen splitting information 112 to a transformation origin block reproducer 10. The demultiplex/decoder also provides transformation parameters 110 to a picture transform generator 6. Transformation origin block reproducer 10 forwards a transformation origin block 106 corresponding to the provided number or address 108 of the second block portion to the picture transfer generator 6, and the picture transform

generator carries out a transform on transformation origin block 106 using the provided transform parameter 110. Picture memory 11 stores a plurality of transformed block portions 107 output from picture transform generator 6, and the output of the picture memory is coupled to a controller 12 for controlling a series of iterative loops for the decoding apparatus. An area extractor 28 extracts a predetermined area from the picture to be output by the decoding device.

Detailed Description Text - DETX:

A transformed block portion 107 thus obtained from picture transform generator 6 is provided to and stored in picture memory 11 at a position designated by the number or address 111 of the first block portion. This procedure is repeated until the entire decoding target coded bit stream has been read out, and all of the second transformed block portions 107 have been written into the picture memory. Then, this picture information is fed back to transformation origin block producer 10 under the control of controller 12 which couples a control signal 116 to the transformation origin block reproducer. Thus, the IFS decoding procedure is performed on only the transformed second block portions stored in picture memory 11 in an iterative, recursive procedure for a predetermined number of iterations. After the predetermined number of iterations have been performed, the finally decoded picture 117 is provided

from controller 12 to target area extractor 28 which **selects and displays only the portion of the picture designated by the decoding target area information 128 and outputs this selected** information as an output picture 150. It should be appreciated that while less than the entire picture need be decoded, more than the final display is likely to be decoded. For example, if a user wishes to display a portion of a picture in area 1, and a portion of a picture in an area 2, the entire area 1 and area 2 are decoded, but areas 3, 4 and any subsequent areas need not be decoded.

Current US Cross Reference Classification - CCXR:

382/233

	Type	Hits	Search Text	DBs
1	BRS	241	wavelet near3 (decod$3 or decompress$3)	USPAT; EPO; JPO; DERWENT
2	BRS	533	iwt or inverse adj2 wavelet	USPAT; EPO; JPO; DERWENT
3	BRS	658	(wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)	USPAT; EPO; JPO; DERWENT
4	BRS	4785	object near6 coefficient	USPAT; EPO; JPO; DERWENT
5	BRS	2	((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)) with (object near6 coefficient)	USPAT; EPO; JPO; DERWENT
6	BRS	4	("5862260" | "5867602" | "5966465" | "5999656").PN.	USPAT
7	BRS	2	((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)) same (object near6 coefficient)	USPAT; EPO; JPO; DERWENT
8	BRS	122	object with boundary with coefficient	USPAT; EPO; JPO; DERWENT
9	BRS	3	((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)) and (object with boundary with coefficient)	USPAT; EPO; JPO; DERWENT
10	BRS	6	("5412741" | "5436985" | "5546477" | "5748786" | "5828849" | "5901249").PN.	USPAT
11	BRS	5	object with boundary with coefficient with only	USPAT; EPO; JPO; DERWENT
12	BRS	2	specif$3 with (object with boundary with coefficient)	USPAT; EPO; JPO; DERWENT
13	BRS	0	wavelet near3 (decod$3 or decompress$3) with partially	USPAT; EPO; JPO; DERWENT
14	BRS	658	(wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)	USPAT; EPO; JPO; DERWENT
15	BRS	1	wavelet near3 (decod$3 or decompress$3) with partial$3	USPAT; EPO; JPO; DERWENT
16	BRS	44	((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)) with (object or area or region)	USPAT; EPO; JPO; DERWENT
17	BRS	122	object with boundary with coefficient	USPAT; EPO; JPO; DERWENT
18	BRS	3	((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)) and (object with boundary with coefficient)	USPAT; EPO; JPO; DERWENT
19	BRS	0	(object with boundary with coefficient) and Das-a$.in.	USPAT; EPO; JPO; DERWENT
20	BRS	0	((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet)) and Das-a$.in.	USPAT; EPO; JPO; DERWENT
21	BRS	108	Das-a$.in.	USPAT; EPO; JPO; DERWENT
22	BRS	3679	video adj2 object or vop	USPAT; EPO; JPO; DERWENT

	Type	Hits	Search Text	DBs
23	BRS	0	(video adj2 object or vop) same ((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet))	USPAT; EPO; JPO; DERWENT
24	BRS	20	(video adj2 object or vop) and ((wavelet near3 (decod$3 or decompress$3)) or (iwt or inverse adj2 wavelet))	USPAT; EPO; JPO; DERWENT
25	BRS	5	("5649032" | "5692063" | "5991453" | "6026195" | "6069976").PN.	USPAT
26	BRS	414	382/233.ccls.	USPAT; EPO; JPO; DERWENT
27	BRS	114161	(select$6 or partial$3) with (decod$3 or decompress$3 or reconstruct$3 or expand$3)	USPAT; EPO; JPO; DERWENT
28	BRS	219	382/233.ccls. and ((select$6 or partial$3) with (decod$3 or decompress$3 or reconstruct$3 or expand$3))	USPAT; EPO; JPO; DERWENT
29	BRS	30	(382/233.ccls. and ((select$6 or partial$3) with (decod$3 or decompress$3 or reconstruct$3 or expand$3))) and wavelet	USPAT; EPO; JPO; DERWENT
30	BRS	8	("4982345" | "5434567" | "5764802" | "5867602" | "5905815" | "5966465" | "6141446" | "6163626").PN.	USPAT
31	BRS	3	("5321776" | "5748116" | "5881176").PN.	USPAT
32	BRS	78856	(select$6 or partial$3) near6 (decod$3 or decompress$3 or reconstruct$3 or expand$3)	USPAT; EPO; JPO; DERWENT
33	BRS	1	panoramic and (((select$6 or partial$3) near6 (decod$3 or decompress$3 or reconstruct$3 or expand$3)) and 382/233.ccls.)	USPAT; EPO; JPO; DERWENT
34	BRS	180	((select$6 or partial$3) near6 (decod$3 or decompress$3 or reconstruct$3 or expand$3)) and 382/233.ccls.	USPAT; EPO; JPO; DERWENT
35	BRS	16	5408328.URPN.	USPAT
36	BRS	806	panoramic with frame	USPAT; EPO; JPO; DERWENT
37	BRS	0	segement$3 with (panoramic with frame)	USPAT; EPO; JPO; DERWENT
38	BRS	4	(decod$3 or decompress$3) with (panoramic with frame)	USPAT; EPO; JPO; DERWENT

	Type	Hits	Search Text	DBs
41	BRS	15	6043837.URPN.	USPAT
42	BRS	15	panoramic with frame with (subset or segment)	USPAT; EPO; JPO; DERWENT

	Time Stamp	Comments	Error Definition	Errors
41	2003/03/07 09:33			0
42	2003/03/07 09:40			0